Lafourche Parish Government
WORKFORCE HOUSING ECONOMIC STUDY

Lafourche Employment and Oil Market Analysis

December 2015

digital engineering

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INTRODUCTION

TMG Consulting assessed the current and potential employment market of Lafourche Parish, Louisiana. Specifically, Parish officials have been concerned about parish employment levels in light of recent declines in the price of oil. To assess potential future employment magnitude, historical employment data and various oil market metrics were analyzed to determine the relationship between the two. The result of this analysis is a set of projections for future employment amounts segmented by sector, based on the price of oil.

Background and Contemporary Oil Market Volatility

Between June 2014 and January 2015 the world economy suffered the third largest decline of cumulative oil price in the past 30 years (Baffes et al. 2015). Driven by the combination of multiple factors, including the Organization of the Petroleum Exporting Countries' (OPEC) decision to keep production levels high, geopolitical risks that did not materialize into supply disruptions, and continued low interest rates, the price of oil per barrel dropped from $106.18 in June 2014 to $43.39 in October 2015, further dipping into the mid-thirties dollar level thereafter (Baffes et al. 2015, Brown 2015, U.S. Energy Information Administration 2015). Due to the drop in the price of oil, energy companies have responded with a decrease in overall investment and a subsequent loss of employment.

The nearest correlate to the current fall in oil-and-gas prices is the 1985-1986 oil price collapse (Baffes et al. 2015, Brown 2015). However, unlike today's oil market volatility which is generally attributable to increases in production productivity, the 1985-1986 oil price collapse is rooted in the internal politics of OPEC extending from 1970 through 1985. Nevertheless, a review of the historical connection between oil market metrics and employment levels and the methodology for determining those relationships is appropriate.

Despite falling prices of oil, OPEC made the decision in November 2014 to continue daily output of 30 million barrels of oil per day (Eder et al. 2015). The continued high production of oil from OPEC coupled with the introduction of increased yields produced by shale and deep sea oil reserves in North America kept the price of oil down throughout 2015. While the low prices have impacted the overall dividends of OPEC partners, the effects have been relatively negligible in comparison to the oil-and-gas industry in the United States and Canada. Exploratory projects in North America have been largely scaled back, including the Obama administration's rejection of the famous "Keystone XL" pipeline to move extracted tar sand oil in southern Canada throughout the continent.

Within the United States, the canceling of projects has resulted in varying levels of employment loss in oil-and-gas producing states, like Louisiana, Texas, and North Dakota, ranging from 0.1% - 4% (Brown 2015). As of October 2015, only 787 domestic oil-and-gas rigs are in use—52 on land and 35 offshore (Hughes 2015), and the rig count continues to fall. This is a significant decrease from just one year ago, with 1,927 active oil-and-gas rigs—1,872 on land and 55 offshore. Brown (2015) indicates that on average during one month of nonoperation of a single oil rig, approximately 28 direct jobs are lost, during six months approximately 94 jobs are lost, and during the "long run" (or greater than 6 months) approximately 171 jobs are lost. This does not take into account the other sectors that are impacted by the oil-and-gas industry, such as local government revenue loss, transportation industry loss, and a reduction in secondary industry development.

However, the decrease in employment, as well as the scaling back or canceling of projects, has not meant that overall production in the U.S. is dropping across all oil market sectors. In 2014 the United States produced 8,713,000 barrels of crude oil and 3,010,000 barrels of natural gas liquids per day (U.S. EIA 2015). Both forms of petroleum are projected to grow in production in 2015 with 9,250,000 barrels of crude oil and 3,370,000 barrels of natural gas liquids produced per day (U.S. EIA 2015). While production of natural gas liquids is projected to continue to grow in 2016, reaching 3,610,000 barrels per day, production of crude oil is projected to slow, dipping to 8,860,000 barrels per day (U.S. EIA 2015). The ability of the U.S. to produce higher yields of crude oil and natural gas liquids with a smaller workforce is a testament to the advances in technologies focused on the extraction of hydrocarbons. However, over the long run the diminishing returns and the high net cost of such extraction technologies (without a price recovery) will eventually lead to further closures of U.S. based operations, and diminished production as suggested by the 2016 crude oil projections.

Louisiana, while not as heavily impacted by the decrease in oil prices as states like Texas and North Dakota, has been impacted by the decrease in rig activity. In October of 2014 a total of 110 rigs were in use throughout the state (Baker 2015). Currently there are only 56 operational rigs, indicating a 49% decrease in rig use (2015). Following the projections used by Brown (2015), the loss of jobs due to the inactivity of 54 rigs totals approximately 9,257 individuals. This job loss projection is compounded by the impact to other sectors of the oil-and-gas industry, including support staff. Recently, Holland-based Royal Dutch Shell Co. has announced that they will be eliminating 10,300 jobs worldwide with expected cuts to the local workforce based out of One Shell Square in New Orleans (Lipinski 2015).

During the early portions of the oil price crash, a myriad of analysts from Reuters, The Wall Street Journal, and the Fiscal Times suggested that oil price would rebound in the second half of 2015 (Samanta and Vedala 2014, Kent 2015, Brush 2015). However, late in the year the industry is still seeing low prices with no end in sight. Recently, Don Briggs, the president of the Louisiana Oil & Gas Association, presented a bleak view of the oil-and-gas industry in the U.S., suggesting that the "downturn could indeed be a longer term new normal for the U.S market" (Briggs 2015). It is clear that the future of U.S. (and specifically Louisiana) oil-and-gas markets is uncertain. To reduce spending, while continuing relatively high production, U.S. oil-and-gas companies have started to shelve high risk-high reward strategies, such as drilling in the Gulf of Mexico, to low risk and economically "safe" projects, like horizontal shale operations (Carroll 2015). While this shift may maintain oil producers' profit margins, movement away from deep-water drilling will significantly impact Louisiana.

A full review and analysis of past academic and practical examinations of the impact of oil market metrics on employment levels is provided as an Appendix to this report.

Contemporary Changes in Lafourche Oil Industry

In terms of current changes in the oil industry affecting Lafourche Parish, there are cross-trends that could impact both the number of Lafourche residents with jobs and the total number of jobs located in the Parish. Shell recently discovered approximately 100 million barrels of oil in the Gulf[1]. Rebecca Fitz, senior director at IHS Energy, says that "[T]his discovery is completely consistent with what Shell is trying to do from its streamlined exploration program. If you can deliver 100 million barrels of crude oil and have all the infrastructure built, that should be a pretty high value, quick lead-time tie-back development." This could be a boon to South Lafourche, as according to Port Fourchon officials, Shell is

[1] http://fuelfix.com/blog/2015/11/18/shell-finds-100m-oil-barrels-at-deep-gulf-discovery/#34117101=0

consolidating its Gulf of Mexico operations at the Port. Meanwhile, Chevron is spending $29 million to relocate its Gulf of Mexico airbase facility to the South Lafourche Leonard Miller Jr. Airport[2], but is implementing layoffs of some staff in Louisiana as part of a broader contraction in labor needs[3]. Other firms connected to the industry are also contemplating or implementing layoffs[4]. Although changes to the job market occurring in real-time are by definition not captured in the historical data used to establish the mathematical relationships in this report, the statistical robustness of those relationships is such that new information can continue to inform the model's projections over time.

[2] http://www.houmatoday.com/article/20131106/ARTICLES/131109690
[3] http://www.nola.com/business/index.ssf/2015/09/chevron_layoffs_northpark_covi.html
[4] http://www.houmatoday.com/article/20150121/ARTICLES/150129905

LAFOURCHE EMPLOYMENT RELATIONSHIP TO OIL MARKET METRICS

Parish-Wide Data Comparisons

In order to best understand the employment levels in Lafourche Parish, TMG examined data from two sources: the U.S. Census and the U.S. Bureau of Economic Analysis (BEA). The Census data, which are organized and presented by Pitney Bowes Inc. through their AnySite location intelligence software, are based on where the survey respondent lives. This census data describes two variables, "employed" and "workers". The employed variable includes all civilians 16 years of age and over who worked and were paid for at least 15 hours in a reference work week or were considered with a job but not at work during the reference week. This does not include those whose activity consisted of work around the house or unpaid volunteer work for religious, charitable, and similar organizations. Also excluded are all institutionalized people and people on active duty in the United States Armed Forces. The workers variable includes all civilians 16 years of age and over, as well as members of the Armed Forces.

The BEA data, while reporting on similar areas of analysis, are based on surveys of businesses and present employment data by place of work. This data includes both full-time and part-time employees, sole proprietors, and general partners. The differential between the Census and BEA data in Lafourche has increased recently, indicating that the number of jobs located in the Parish is outpacing the number of working residents. Lafourche now has thousands of individuals who reside outside the Parish and commute into the Parish for work. See Table 1.

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Table 1: Lafourche Employment Data—Census vs. BEA

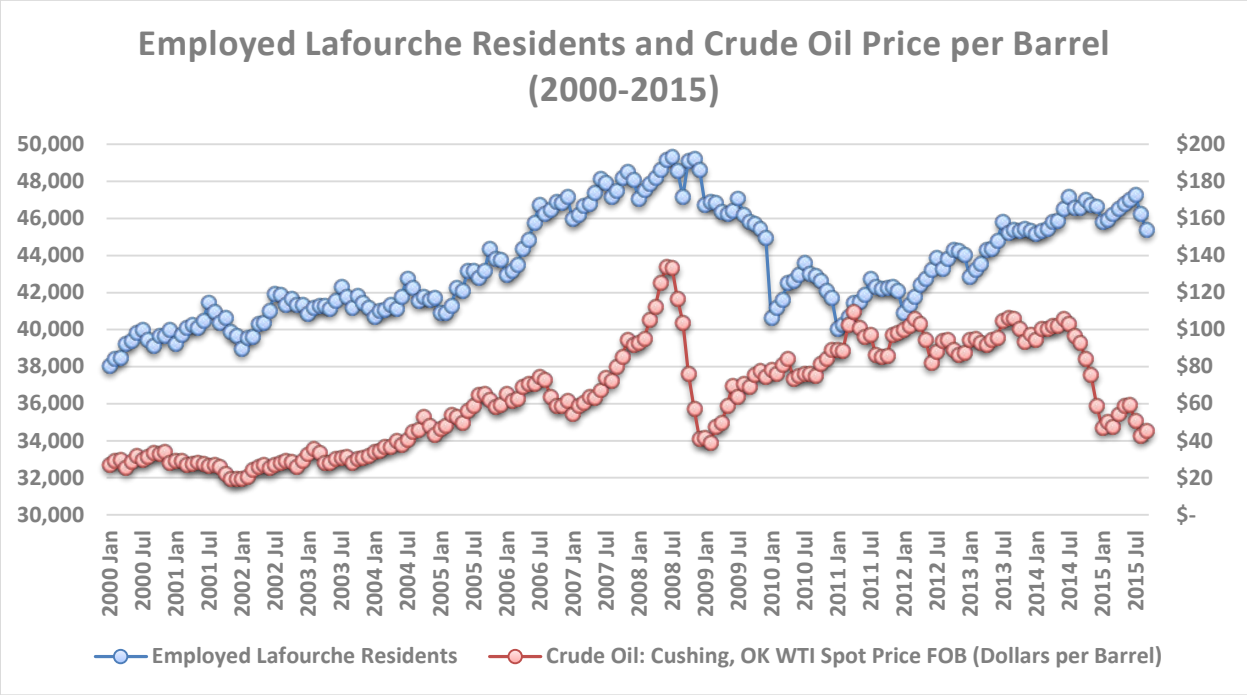
Year	Census *Residents Working*	BEA *Job Location*	Differential
2002	41,372	49,857	21%
2003	41,190	51,832	26%
2004	41,713	51,537	24%
2005	43,799	52,228	19%
2006	47,188	55,664	18%
2007	48,083	58,876	22%
2008	48,666	60,292	24%
2009	45,001	59,551	32%
2010	41,712	59,795	43%
2011	42,091	59,458	41%
2012	44,067	61,513	40%
2013	45,334	63,815	41%

Source: U.S. Census; Bureau of Economic Analysis

There are advantages and disadvantages to each data source. Census jobs data are available monthly, allowing for more data points in a quantitative analysis, but has fewer available employment sector categories, limiting the specific conclusions that can be drawn. Due to its location-based job surveys,

BEA data has a higher number of employment sector categories and may be more relevant to determine the types of workers who access Parish transportation networks and could potentially need access to temporary housing, but is only available annually. Using the additional data points from Census data, a relationship between Lafourche resident jobs vs. the price of crude oil (according to U.S. Energy Information Association (EIA)) has been established in the following chart (Figure 1). The price of crude oil and number of Lafourche resident jobs are clearly highly correlated.

Figure 1: Employed Lafourche Residents and Crude Oil Price per Barrel (2000-2015)



Source: U.S. Census; U.S. Energy Information Administration

How Oil Market Metrics Relate to Parish Employment Levels

In order to measure the strength of the relationship between Parish employment levels and various measures of the oil market, and use that knowledge to make predictions about how one might affect the other, TMG applied a simple linear regression model to various variables. TMG first "regressed" eight oil market variables against Census employment data in Lafourche. In order to identify which specific measures of the health of the oil market are most related to employment in levels in Lafourche, TMG tested three oil price metrics, three production metrics, a sales metric, and stock metric. In order to account for the possibility that changes in the oil market are a leading indicator of employment impacts and might not affect employment levels in real time, TMG also tested a 3-month and 6-month lag time (total of 24 regressions: see Tables 2-4). For instance, a 3-month lag result indicates the projected employment for a period three months after the related oil market metric was attained.

REGRESSION MODELS

To interpret the regression results:

R squared – The percentage of the variation in the dependent variable (employment level) that can be explained by the independent variable (oil market metric). For example, an R squared value of over 0.50 indicates that more than half of the change in the employment level can be explained by a change in the oil market metric (highlighted in green below). R squared values of 0.20 or below indicate low predictive power of the magnitude of variations in the labor market (highlighted in pink).

Significance - A measure of statistical robustness that indicates the reliability of the results; values .05 or above should be heavily discounted or ignored (highlighted in yellow).

Key	
Over 50% variability explained	
Less than 20% variability explained	
Result not statistically significant	

Given a result of a regression of two variables with high predictive power and statistical significance, an equation to predict the mathematical relationship between changes in the two variables can be used. The coefficient and multiplier serve to quantify this relationship.

Dependent variable (employment level) = Coefficient + Multiplier x Independent variable (oil market metric).

Table 2: Regression Analysis: Resident Jobs vs. Price

			Crude Oil: Cushing, OK WTI Spot Price FOB (Dollars per Barrel)	Conventional Gasoline: U.S. Gulf Coast Conventional Gasoline Regular Spot Price FOB (Dollars per Gallon)	Retail Prices: U.S. Total Gasoline Through Company Outlets Price by All Sellers (Dollars per Gallon)
Resident Jobs	Real-Time	R squared	0.30	0.26	0.53
		Significance	0.00	0.00	0.00
		Coefficient	40,088	40,305	37,420
		Multiplier	54.27	1,838.46	3,343.76
	3-Month Lag	R squared	0.34	0.32	0.53
		Significance	0.00	0.00	0.00
		Coefficient	40,019	40,136	37,624
		Multiplier	56.42	1,978.33	3,263.35
	6-Month Lag	R squared	0.35	0.31	0.47
		Significance	0.00	0.00	0.00
		Coefficient	40,116	40,312	38,127
		Multiplier	55.86	1,918.75	3,009.05

Source: U.S. Census; U.S. Energy Information Administration; TMG Consulting analysis

All price metrics are substantially explanatory (over 25% of employment variation explained) and statistically significant.

Table 3: Regression Analysis: Resident Jobs vs. Production

			Crude Oil Production: Gulf Coast (PADD 3) Field Production of Crude Oil (Thousand Barrels)	Crude Oil Production: Louisiana Field Production of Crude Oil (Thousand Barrels)	Offshore Rigs
Resident Jobs	Real-Time	R squared	0.04	0.37	0.25
		Significance	0.01	0.00	0.00
		Coefficient	41,131	53,479	46,663
		Multiplier	0.02	-1.51	-48.74
	3-Month Lag	R squared	0.03	0.35	0.20
		Significance	0.01	0.00	0.00
		Coefficient	41,436	53,068	46,375
		Multiplier	56.42	-1.43	-42.48
	6-Month Lag	R squared	0.02	0.33	0.18
		Significance	0.04	0.00	0.00
		Coefficient	41,754	52,849	46,312
		Multiplier	0.02	-1.38	-39.72

Source: U.S. Census; U.S. Energy Information Administration; TMG Consulting analysis

All production metrics are statistically significant but only crude oil production explains a significant portion of the change in employment. Notably, this relationship is negative, confirming the fear that technological progress leading to increased production across Louisiana may in fact reduce the number of jobs in Lafourche.

Table 4: Regression Analysis: Resident Jobs vs. Sales and Stocks

			Prime Supplier Sales Volumes: U.S. Total Gasoline All Sales/Deliveries by Prime Supplier (Thousand Gallons per Day)	Stocks (Refinery, Bulk Terminal, and Natural Gas Plant): U.S. Finished Motor Gasoline Stocks at Refineries, Bulk Terminals, and Natural Gas Plants (Thousand Barrels)
Resident Jobs	Real-Time	R squared	0.02	0.29
		Significance	0.07	0.00
		Coefficient	34,655	46,925
		Multiplier	0.02	-0.05
	3-Month Lag	R squared	0.01	0.26
		Significance	0.31	0.00
		Coefficient	38,781	46,838
		Multiplier	0.01	-0.05
	6-Month Lag	R squared	0.00	0.23
		Significance	0.49	0.00
		Coefficient	47,027	46,744
		Multiplier	-0.01	-0.04

Source: U.S. Census; U.S. Energy Information Administration; TMG Consulting analysis

Sales and stocks data is problematic. Sales data is not statistically significant or predictive; the stocks metric has a strong relationship to employment but the small multiplier indicates that this is largely a function of a stable coefficient.

The variable with the strongest predictive strength is the U.S. retail price of gasoline in real-time or with a 3-month lag, explaining *over half* the variation in employment. As noted, the number of offshore rigs, production in the Gulf, and supplier sales volumes are not especially predictive and/or statistically significant. See Table 5.

Table 5: Predictive Strength of Oil Market Metrics

Time Lag	Oil Market Metric	R squared
Real-Time	Retail Gas	0.53
3-Month Lag	Retail Gas	0.53
6-Month Lag	Retail Gas	0.47
Real-Time	LA Production	0.37
3-Month Lag	LA Production	0.35
6-Month Lag	Crude Price	0.35
3-Month Lag	Crude Price	0.34
6-Month Lag	LA Production	0.33
3-Month Lag	Gas Price	0.32
6-Month Lag	Gas Price	0.31
Real-Time	Crude Price	0.30
Real-Time	Gas Stocks	0.29
3-Month Lag	Gas Stocks	0.26
Real-Time	Gas Price	0.26
Real-Time	Offshore Rigs	0.25
6-Month Lag	Gas Stocks	0.23
3-Month Lag	Offshore Rigs	0.20
6-Month Lag	Offshore Rigs	0.18
Real-Time	Gulf Production	0.04
3-Month Lag	Gulf Production	0.03
6-Month Lag	Gulf Production	0.02
Real-Time	Sales Volume	0.02
3-Month Lag	Sales Volume	0.01
6-Month Lag	Sales Volume	0.00

Source: U.S. Census; U.S. Energy Information Administration; TMG Consulting analysis

EMPLOYMENT PROJECTIONS

Total Lafourche Resident Employment

TMG then chose the four variables with the most interesting regression outputs to project monthly overall Lafourche resident employment in 2016 based on third-party projections of the oil (independent) variables: crude oil price, retail gas price, crude oil production, and motor gas stocks. (Although the wholesale price of gasoline has a robust relationship to employment, the other two price metrics were superior; motor gas stocks is included as it was the only available stocks metric to test with monthly data points). The findings indicate that the number of resident jobs will follow a typical seasonal pattern in 2016, but at a potentially lower level. A chart demonstrating this pattern has been provided for retail gas price (Figure 2), the most predictive variable. Note that the results across variables vary, predicting between approximately 42,000 jobs and 47,000 jobs for Lafourche Residents, similar to the actual 2013 level of 45,334. See Tables 6-9.

Table 6: Projected Lafourche Resident Jobs: Crude Oil Price

Date	Real-time	3 Month Lag	6 Month Lag
Jan 2016	42,639	42,670	42,742
Feb 2016	42,639	42,670	42,742
Mar 2016	42,693	42,727	42,798
Apr 2016	42,747	42,896	42,854
May 2016	42,856	43,065	42,965
Jun 2016	43,019	43,065	43,133
Jul 2016	43,019	43,065	43,133
Aug 2016	43,019	43,065	43,133
Sep 2016	43,019	43,065	43,133
Oct 2016	42,964	43,009	43,077
Nov 2016	42,910	42,952	43,021
Dec 2016	42,910	42,952	43,021

Source: TMG Consulting analysis

Table 7: Projected Lafourche Resident Jobs: Retail Gas Price

Date	Real-time	3 Month Lag	6 Month Lag
Jan 2016	41,983	42,077	42,233
Feb 2016	42,153	42,243	42,386
Mar 2016	42,703	42,780	42,881
Apr 2016	43,152	43,411	43,285
May 2016	43,350	43,539	43,463
Jun 2016	43,481	43,496	43,581
Jul 2016	43,437	43,370	43,542
Aug 2016	43,308	43,370	43,425
Sep 2016	43,059	43,127	43,201
Oct 2016	42,708	42,785	42,885
Nov 2016	42,441	42,523	42,645
Dec 2016	42,259	42,347	42,482

Source: TMG Consulting analysis

Figure 2: Projected 2016 Employment based on Retail Gasoline Price Projections

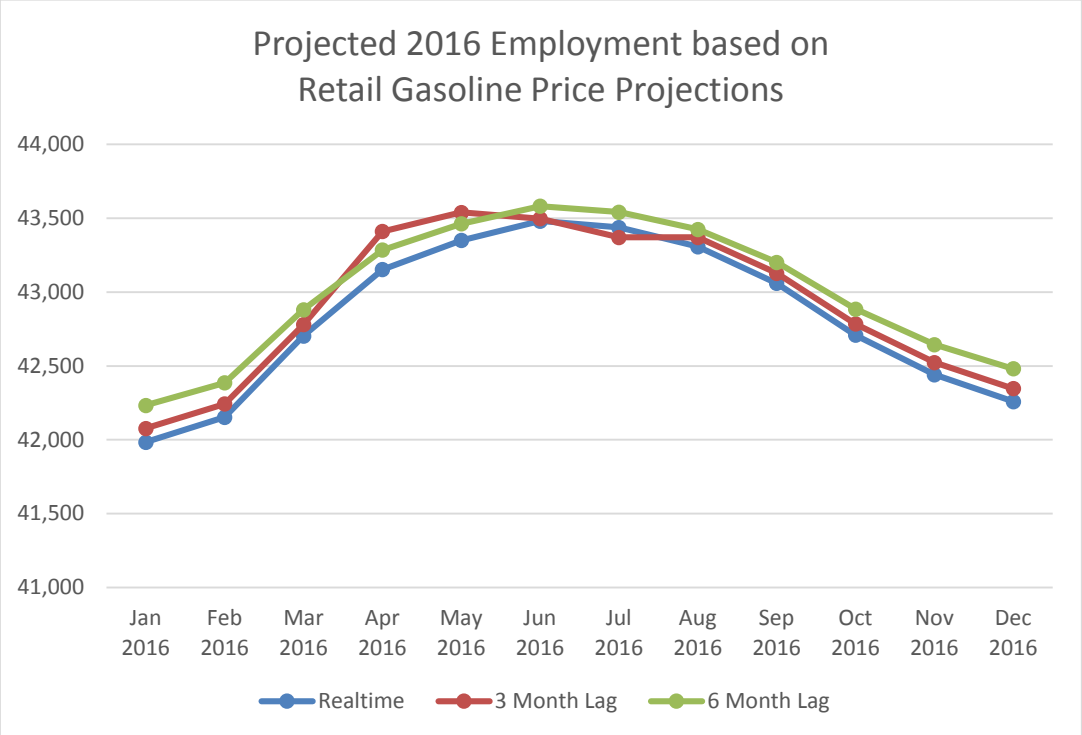


Table 8: Projected Lafourche Resident Jobs: Crude Oil Production

Date	Real-time	3 Month Lag	6 Month Lag
Jan 2016	45,041	45,077	45,125
Feb 2016	45,028	45,065	45,114
Mar 2016	45,043	45,078	45,127
Apr 2016	45,084	45,181	45,165
May 2016	45,151	45,269	45,226
Jun 2016	45,244	45,381	45,312
Jul 2016	45,363	45,516	45,420
Aug 2016	45,505	45,516	45,550
Sep 2016	45,670	45,672	45,701
Oct 2016	45,856	45,849	45,872
Nov 2016	46,062	46,044	46,060
Dec 2016	46,286	46,256	46,265

Source: TMG Consulting analysis

Table 9: Projected Resident Jobs: Motor Gasoline Stocks

Date	Real-time	3 Month Lag	6 Month Lag
Jan 2016	46,923	46,837	46,742
Feb 2016	46,923	46,837	46,742
Mar 2016	46,923	46,837	46,743
Apr 2016	46,924	46,837	46,743
May 2016	46,923	46,837	46,743
Jun 2016	46,923	46,837	46,743
Jul 2016	46,923	46,837	46,743
Aug 2016	46,923	46,837	46,743
Sep 2016	46,923	46,837	46,743
Oct 2016	46,924	46,837	46,743
Nov 2016	46,923	46,837	46,743
Dec 2016	46,923	46,837	46,742

Source: TMG Consulting analysis

Lafourche Resident Employment by Sector

Next, TMG regressed those four oil variables across six Census sectors (categories that were available monthly) in real-time, 3-mo, and 6-mo lags (total of 72 regressions: see Table 10). "Private – Other," "Goods Producing," and "Natural Resources and Mining" sectors are highly influenced by more than one oil market variable/time-frame. The Construction sector is highly sensitive to price metrics but is not significantly influenced by production or stocks metrics. Government and Manufacturing are much less responsive to the oil market.

Table 10: Projected Resident Jobs by Sector

			PRICE		PRODUCTION	STOCKS
			Crude Oil	Gasoline Retail Prices	Crude Oil Production	U.S. Motor Gasoline Stocks
Government	Real-Time	R squared	0.22	0.15	0.13	0.26
		Significance	0.00	0.00	0.00	0.00
		Coefficient	7,168	7,133	7,564	6,456
		Multiplier	-4.93	-114.27	-0.01	0.01
	3-Month Lag	R squared	0.21	0.14	0.12	0.28
		Significance	0.00	0.00	0.00	0.00
		Coefficient	7,157	7,129	7,573	6,423
		Multiplier	-4.81	-115.43	-0.01	0.01
	6-Month Lag	R squared	0.15	0.05	0.09	0.26
		Significance	0.00	0.01	0.00	0.00
		Coefficient	7,111	7,049	7,551	6,420
		Multiplier	-4.81	-73.80	-0.01	0.01
Goods Producing	Real-Time	R squared	0.52	0.41	0.24	0.57
		Significance	0.00	0.00	0.00	0.00
		Coefficient	7,010	4,902	3,927	7,125
		Multiplier	-0.02	444.98	0.02	-0.02
	3-Month Lag	R squared	0.54	0.44	0.20	0.57
		Significance	0.00	0.00	0.00	0.00
		Coefficient	4,908	4,889	3,981	7,171
		Multiplier	15.89	459.65	0.02	-0.02
	6-Month Lag	R squared	0.52	0.41	0.16	0.57
		Significance	0.00	0.00	0.00	0.00
		Coefficient	4,929	4,925	4,069	7,226
		Multiplier	15.83	446.92	0.02	-0.02
Natural Resources and Mining	Real-Time	R squared	0.41	0.16	0.16	0.68
		Significance	0.00	0.00	0.00	0.00
		Coefficient	823	972	4,069	1,920
		Multiplier	6.84	82.25	0.02	-0.01
	3-Month Lag	R squared	0.43	0.22	0.50	0.57
		Significance	0.00	0.00	0.00	0.00
		Coefficient	817	951	-249	7226
		Multiplier	7.07	100.73	0.02	-0.02

			Crude Oil	Gasoline Retail Prices	Crude Oil Production	U.S. Motor Gasoline Stocks
Natural Resources and Mining	6-Month Lag	R squared	0.46	0.26	0.41	0.69
		Significance	0.00	0.00	0.00	0.00
		Coefficient	807	931	-219	1982
		Multiplier	7.35	116.97	0.02	-0.01
Construction	Real-Time	R squared	0.43	0.60	0.01	0.29
		Significance	0.00	0.00	0.24	0.00
		Coefficient	1311	1043	1961	2229
		Multiplier	7.33	410.85	0.00	-0.01
	3-Month Lag	R squared	0.39	0.49	0.02	0.26
		Significance	0.00	0.00	0.08	0.00
		Coefficient	1,358	1,135	2,084	2,222
		Multiplier	6.82	410.85	0.00	-0.01
	6-Month Lag	R squared	0.33	0.43	0.04	0.25
		Significance	0.00	0.00	0.02	0.00
		Coefficient	1,409	1,201	2,227	2,224
		Multiplier	6.22	330.91	0.00	-0.01
Manufacturing	Real-Time	R squared	0.02	0.02	0.17	0.03
		Significance	0.04	0.11	0.00	0.02
		Coefficient	2,778	2,886	2,213	2,976
		Multiplier	1.33	-48.13	0.01	0.00
	3-Month Lag	R squared	0.05	0.00	0.17	0.05
		Significance	0.00	0.92	0.00	0.00
		Coefficient	2,733	2,802	2,145	3,002
		Multiplier	2.00	-3.07	0.01	0.00
	6-Month Lag	R squared	0.07	0.00	0.19	0.06
		Significance	0.00	0.97	0.00	0.00
		Coefficient	2,712	2,793	2,061	3,021
		Multiplier	2.26	-0.96	0.01	0.00
Private Other	Real-Time	R squared	0.72	0.64	0.07	0.76
		Significance	0.00	0.00	0.00	0.00
		Coefficient	13,345	12,634	13,744	22,050
		Multiplier	61.73	2307.58	0.04	-0.07
	3-Month Lag	R squared	0.66	0.58	0.05	0.75
		Significance	0.00	0.00	0.00	0.00
		Coefficient	13,702	13,065	14,259	14,259
		Multiplier	57.88	2135.51	0.03	0.03
	6-Month Lag	R squared	0.60	0.51	0.02	0.74
		Significance	0.00	0.00	0.04	0.00
		Coefficient	14,092	13,522	15,104	22,139
		Multiplier	53.40	1948.12	0.02	-0.06

Table 11 presents a summary of the highest predictive value across all oil metrics for each individual sector. Because Motor Gasoline Stocks was highly predictive but has very little variability, a summary of results against Crude Oil price alone – for the most predictive time lag – has been presented. See Table 12.

Table 11: Resident Jobs by Sector—Strongest Relationships

Sector	Independent Variable	Test	Indicators	Data
Government	Motor Gasoline Stocks	3-Month Lag	R squared	0.28
			Significance	0.00
			Coefficient	6,423
			Multiplier	0.01
Goods Producing	Motor Gasoline Stocks	Real-Time	R squared	0.57
			Significance	0.00
			Coefficient	7,125
			Multiplier	(0.02)
Natural Resources and Mining	Motor Gasoline Stocks	6-Month Lag	R squared	0.69
			Significance	0.00
			Coefficient	1,982
			Multiplier	(0.01)
Construction	Retail Gasoline Price	Real-Time	R squared	0.60
			Significance	0.00
			Coefficient	1,043
			Multiplier	410.85
Manufacturing	Louisiana Crude Oil Production	6-Month Lag	R squared	0.19
			Significance	0.00
			Coefficient	2,061
			Multiplier	0.01
Private Other	Motor Gasoline Stocks	Real-Time	R squared	0.76
			Significance	0.00
			Coefficient	22,050
			Multiplier	(0.07)

Table 12: Resident Jobs by Sector—Crude Oil Price

Sector	Independent Variable	Test	Indicators	Data
Government	Crude Oil Price	Real-Time	R squared	0.22
			Significance	0.00
			Coefficient	7,168
			Multiplier	(4.93)
Goods Producing	Crude Oil Price	3-Month Lag	R squared	0.54
			Significance	0.00
			Coefficient	4,908
			Multiplier	15.89
Natural Resources and Mining	Crude Oil Price	6-Month Lag	R squared	0.46
			Significance	0.00
			Coefficient	807
			Multiplier	7.35
Construction	Crude Oil Price	Real-Time	R squared	0.43
			Significance	0.00
			Coefficient	1,311
			Multiplier	7.33
Manufacturing	Crude Oil Price	6-Month Lag	R squared	0.07
			Significance	0.00
			Coefficient	2,712
			Multiplier	2.26
Private Other	Crude Oil Price	Real-Time	R squared	0.72
			Significance	0.00
			Coefficient	13,345
			Multiplier	61.73

The Parish is particularly interested in the relationship between employment and crude oil price, a dynamic metric important to stakeholders in Lafourche. Using the regression results for crude oil price, TMG projected the number of resident jobs by sector, monthly, through the end of 2016. Note that these results should not be used to determine total resident jobs in the Parish (that analysis was provided earlier); the Census sectors available do not capture all types of employment in the Parish and the regression relationships for individual sectors should not be extrapolated to a total. Notably, the relationship between price of oil and government jobs is negative, perhaps due to workers leaving for higher pay in the oil industry when jobs are available, while oil price swings account for *nearly ¾* of the variation in general private sector employment (Private Other). See Table 13.

Table 13: Projected Resident Jobs by Sector—by Month

Sector	Independent Variable	Timespan	2016 Jan	2016 Feb	2016 Mar	2016 Apr	2016 May	2016 Jun	2016 Jul	2016 Aug	2016 Sep	2016 Oct	2016 Nov	2016 Dec
Government	Crude Oil Price	Real-time	6,936	6,936	6,931	6,927	6,917	6,902	6,902	6,902	6,902	6,907	6,912	6,912
Goods Producing	Crude Oil Price	3-Month	5,655	5,655	5,670	5,686	5,718	5,766	5,766	5,766	5,766	5,750	5,734	5,734
Natural Resources and Mining	Crude Oil Price	6-Month	1,153	1,153	1,160	1,168	1,182	1,204	1,204	1,204	1,204	1,197	1,190	1,190
Construction	Crude Oil Price	Real-time	1,655	1,655	1,663	1,670	1,685	1,707	1,707	1,707	1,707	1,699	1,692	1,692
Manufacturing	Crude Oil Price	6-Month	2,818	2,818	2,820	2,822	2,827	2,834	2,834	2,834	2,834	2,832	2,829	2,829
Private Other	Crude Oil Price	Real-time	16,247	16,247	16,308	16,370	16,493	16,679	16,679	16,679	16,679	16,617	16,555	16,555
Tot. Abv. Secs.			34,464	34,464	34,553	34,643	34,822	35,091	35,091	35,091	35,091	35,002	34,912	34,912

Source: TMG Consulting analysis

Lafourche-located Employment by Sector

Next TMG analyzed the additional categories provided by BEA for jobs located in Lafourche. The Parish saw significant job growth from 2002-2013, but those gains are jeopardized from the recent shocks in the oil market. "Transportation and warehousing" is the most significant employment sector in the Parish. Unlike with the Census sectors, a regression against just the price of Crude Oil across the 21 BEA sectors is less robust (due to annual vs. monthly data points) but produces highly significant results. *Over 80%* of the variability in the "transportation and warehousing" sector, the most important sector to the Lafourche economy, can be attributed to the change in the price of oil. Recall that results with significance values of .05 or greater should be heavily discounted or ignored (Table 14).

Table 14: Regression Analysis: BEA Sectors vs. Price of Oil

Sector	R Squared	Significance	C	Multiplier
Farm employment	0.02	0.70	511.50	(0.13)
Forestry, fishing, and related activities	0.35	0.04	2,220.30	(5.01)
Mining	0.60	0.00	354.31	15.25
Utilities	0.42	0.02	68.14	0.17
Construction	0.15	0.22	3,832.88	8.64
Manufacturing	0.18	0.17	3,096.27	3.82
Wholesale trade	0.11	0.30	819.99	0.83
Retail trade	0.35	0.04	4,818.73	8.34
Transportation and warehousing	0.83	0.00	3,223.70	64.63
Information	0.76	0.00	520.09	(1.70)
Finance and insurance	0.65	0.00	1,253.54	9.49
Real estate and rental and leasing	0.24	0.11	2,815.48	4.46
Professional, scientific, and technical services	0.66	0.00	1,853.87	4.82
Management of companies and enterprises	0.44	0.02	770.49	7.34
Administrative and waste management services	0.04	0.54	3,757.23	3.36
Educational services	0.71	0.00	488.18	2.02
Health care and social assistance	0.81	0.00	2,036.47	20.29
Arts, entertainment, and recreation	0.81	0.00	547.51	5.32
Accommodation and food services	0.78	0.00	2,025.67	8.26
Other services, except public administration	0.78	0.00	2,025.67	8.26
Government and government enterprises	0.80	0.00	2,932.18	8.18

Using the regression results above, TMG projected the number of jobs by sector, annually, through 2020, under two scenarios: a 10% increase in the price of crude oil per year, or a 10% decrease in the price of crude oil per year. If the price increases, the Parish would see job gains of over 8% over the period (Table 15); if prices decreased, the Parish could see losses of over 6% (Table 16). The overall results indicate that swings of that magnitude could translate into less than 48,000 jobs in 2020 or as many as 55,000+ jobs.

Note, however, that these results should not be interpreted as a holistic employment projection for the Parish; the oil market is but one factor that influences job growth and loss in Lafourche. Because some BEA sectors do not have a statistically significant relationship to changes in the price of oil, and because the projected decrease in the price of oil in 2015 (47%) is of significantly greater magnitude than any historical price decrease that informs the regression model (largest previous drop: 38% in 2009), TMG has taken a comprehensive approach to studying employment in the Parish and provided robust employment projections in the full Transportation and Workforce Housing Economic Study.

Table 15: Projected Jobs Located in Lafourche with BEA Sectors

10% Increase in Crude Oil Price per Year	2016	2017	2018	2019	2020
Farm employment	505	504	503	503	502
Forestry, fishing, and related activities	1,964	1,938	1,910	1,879	1,845
Mining	1,136	1,214	1,300	1,394	1,498
Utilities	77	78	79	80	81
Construction	4,276	4,320	4,369	4,422	4,481
Manufacturing	3,292	3,312	3,333	3,357	3,383
Wholesale trade	862	867	871	876	882
Retail trade	5,246	5,289	5,336	5,387	5,444
Transportation and warehousing	6,536	6,867	7,232	7,632	8,073
Information	433	424	415	404	393
Finance and insurance	1,740	1,788	1,842	1,901	1,965
Real estate and rental and leasing	3,044	3,067	3,092	3,120	3,150
Professional, scientific, and technical services	2,101	2,126	2,153	2,183	2,215
Management of companies and enterprises	1,147	1,184	1,226	1,271	1,321
Administrative and waste management services	3,930	3,947	3,966	3,987	4,009
Educational services	592	602	614	626	640
Health care and social assistance	3,076	3,180	3,295	3,420	3,559
Arts, entertainment, and recreation	820	847	877	910	947
Accommodation and food services	2,449	2,491	2,538	2,589	2,645
Other services, except public administration	2,449	2,491	2,538	2,589	2,645
Government and government enterprises	3,352	3,394	3,440	3,490	3,546
Total	**51,041**	**51,947**	**52,944**	**54,040**	**55,246**
% change compared to 2016		***1.8%***	***3.7%***	***5.9%***	***8.2%***

Source: TMG Consulting analysis

Table 16: Projected Jobs Located in Lafourche with BEA Sectors

10% Decrease in Crude Oil Price per Year	2016	2017	2018	2019	2020
Farm employment	505	505	506	507	507
Forestry, fishing, and related activities	1,964	1,989	2,012	2,033	2,052
Mining	1,136	1,058	987	924	867
Utilities	77	76	75	75	74
Construction	4,276	4,231	4,192	4,156	4,123
Manufacturing	3,292	3,272	3,255	3,239	3,225
Wholesale trade	862	858	854	851	848
Retail trade	5,246	5,203	5,165	5,130	5,099
Transportation and warehousing	6,536	6,205	5,907	5,638	5,397
Information	433	442	450	457	463
Finance and insurance	1,740	1,691	1,647	1,608	1,573
Real estate and rental and leasing	3,044	3,021	3,000	2,982	2,965
Professional, scientific, and technical services	2,101	2,076	2,054	2,034	2,016
Management of companies and enterprises	1,147	1,109	1,075	1,045	1,017
Administrative and waste management services	3,930	3,912	3,897	3,883	3,870
Educational services	592	581	572	564	556
Health care and social assistance	3,076	2,972	2,879	2,794	2,719
Arts, entertainment, and recreation	820	793	768	746	726
Accommodation and food services	2,449	2,407	2,369	2,334	2,303
Other services, except public administration	2,449	2,407	2,369	2,334	2,303
Government and government enterprises	3,352	3,310	3,272	3,238	3,207
Total	**51,041**	**50,136**	**49,323**	**48,591**	**47,932**
% change compared to 2016		***-1.8%***	***-3.4%***	***-4.8%***	***-6.1%***

Source: TMG Consulting analysis

SUMMARY

There is a large amount of uncertainty about the state of the oil market even in the short- to medium-term. TMG's analysis indicates that Lafourche's job market, whether measured by its residents' employment or by the number of jobs located in the Parish, is significantly affected by oil market metrics. Certain price metrics, such as the U.S. retail price of gasoline, explain over half the variation in Parish-wide resident jobs. The price of crude oil explains over eighty percent of the variation in the most important sector of jobs located in the Parish (transportation and warehousing). Lafourche's labor market is still heavily strained but could potentially recover in 2016 according to a seasonal pattern if the recent reduction in oil prices is reversed. Although the future of the oil market is uncertain, the regression analyses provided herein can be applied to make employment projections as additional real-time data are obtained in 2016 and beyond.

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APPENDIX

Authors	Time Period Studied	Objective / Abstract	Results	Comparison to Other Studies	Comments
Brown (2015)	2013-2015	This article estimates the response of total employment in oil- and gas-producing states to changes in rig activity caused by changes in oil prices.	Results indicate that removing an active rig eliminates 28 jobs in the first month, 82 jobs after six months, and 171 jobs in the long run. Given the decline in rigs from September 2014 to April 2015, total employment is expected to fall as much as 4 percent in some energy producing states but as little as 0.1 percent in others.		
Chaudhuri (2000)	1973-1996		Real oil prices have an influence on real commodity prices, even if oil is not being used directly in the production of commodities. An oil price change may affect the prices of primary commodities.		
Ciner (2001)	1983-2000		Significant nonlinear causality from crude oil futures returns to S&P 500 index returns and evidence that stock index returns also affect crude oil futures, suggesting a feedback relation. The relation is even stronger in the 1990s.	Confirms Sadorsky's (1999) results of stronger effects of oil price shocks after 1986.	
Davis & Haltiwanger (1999)	1972-1988	Studies the effects of oil price changes and other shocks on the creation and destruction of U.S. manufacturing jobs from 1972 to 1988	Oil price shocks account for about 20-25% of the variance in 2-year-ahead forecast errors for manufacturing employment growth under our identifying assumptions, about twice as much as monetary shocks. The largest oil shock in sample caused an estimated eight percent decline in manufacturing employment within two years.		Emphasize that oil shock response magnitudes vary systematically with observable sectoral characteristics, in some respects sharply. This response heterogeneity is another challenge to business cycle modeling and a useful source of information for assessing model performance.
Ferderer (1996)	1970-1990; daily spot market oil prices	To explain the asymmetry in effects	Volatility and oil price changes have a stronger and more significant impact on economic activity than monetary policy variables. Oil price increases are accompanied by greater volatility. Oil price volatility and the Federal funds rate dominate the oil price level in terms of explaining fluctuations in industrial production. Volatility has a negative and significant impact on output growth immediately and again eleven months later. Oil price changes have a significant impact on output growth after about one year.	U.S. economy is affected by oil market disruptions from the 1970s until the 90s through sectoral shocks and uncertainty as shown by Lee et al.	Ferderer finds evidence that volatility has a greater impact than the oil price level.
Gately (1986)	1970-1986	Historical Review of the 1980's oil and gas price shock	Explanations of the 1985-1986 oil price collapse is rooted in the internal politics of OPEC extending from 1970 through 1985	Associate with Brown (2015) and Hamilton (2012)	
Gisser, Goodwin (1986)	1961-1982		Show that oil price effects on economic output cannot be explained only by monetary and fiscal policy. The relationship between oil price shocks and U.S. economy didn't change after 1973.	Confirm Hamilton´s observation (1983) regarding a similar relationship before and after 1973	
Hamilton (1983)	1948-1980	Demonstrates that historic correlation between oil price increases and economic recessions is not a statistical coincidence.	Oil price increase was followed 3-4 quarters later by slower output growth with a recovery beginning after 6-7 quarters. Nominal oil price increase could be expected to lead to a minor output effect during inflationary times than in noninflationary times		
Hamilton (1996)	1973-1994	Due to the oil price volatility since 1986, the period of the previous year has to be considered rather than only the previous quarter when analyzing oil price development (net oil price increase (NOPI))	Relation between GDP growth and NOPI remains statistically significant for the full period from 1948:1 to 1994:2.	Hamilton agrees completely with Hooker refuting linearity and asymmetry in the oil price macro economy relationship.	
Hamilton (2000)	1949:1999		Oil price increases matter substantially more than oil price decreases. Increases that occur after a long period of stable prices have a bigger impact than those that simply correct previous decreases. From 1949 to 1980 a 10% increase in oil prices resulted four quarters later in a level of GDP growth that was 1.4% lower. But today, there is not enough historical experience to choose one particular functional form unambiguously over another.		
Hamilton (2011)	Key post-World-War-II oil shocks reviewed include the Suez Crisis of 1956-57, the OPEC oil embargo of 1973-1974, the Iranian revolution of 1978-1979, the Iran-Iraq War initiated in 1980, the first Persian Gulf War in 1990-91, and the oil price spike of 2007-2008	paper surveys the history of the oil industry with a particular focus on the events associated with significant changes in the price of oil.			
Hamilton (2012)		paper explores details behind the phenomenal increase in global crude oil production over the last century and a half and the implications if that trend should be reversed			
Herrera & Karaki (2015)	2010-2015	The aim of this paper is threefold. First, use updated time series data on U.S. manufacturing job creation and job destruction, as well as state-of-the-art methods to study the question of asymmetry in the response of U.S. manufacturing job flows to oil price shocks. Second evaluate whether oil price shocks operate mainly through aggregate or allocative channels. Third inquire whether the response of job flows to oil price shocks changed during the Great Moderation.	found no evidence of asymmetry in the response of the job destruction to positive and negative oil price. Oil price innovation lead to a process of job reallocation		Uses a simultaneous equation model.

Hooker (1996)	1948-1994		1948-1972: 10% increase in oil prices led to GDP growth roughly 0.6 % lower in the third and fourth quarters after the shock. 1973-1994: Neither unemployment nor GDP growth can be predicted by oil prices levels. However, GDP growth could be predicted sometimes by volatility	Refutes the linear relation between oil prices and output (Hamilton 1983) and the asymmetric relation based on oil price increases (Mork 1989).	
Jones, Kaul (1996)	US: 1947-1991, Canada 1960-1991, Japan 1970-1991, UK 1962-1991	Objective: examining if stock prices rationally reflect the impact of news on current and future real cash flows in the U.S., Canada, Japan and UK.	Oil price hikes had a "significant, and (on average) detrimental effect on the stock market of each country"[1]. It is "dramatic" in the case of Japan and much weaker for Canada. For each country –except UK – both current and lagged oil price variables affect stock returns negatively. The fact that the latter has a greater negative influence suggests that oil shocks induce some variation in expected stock returns or the stock market's inefficiency.		
Keane & Prasad (1991)	1966-1981	use micro panel data to examine the effects of oil price shocks on employment and real wages, at the aggregate and industry levels. Also measures differences in the employment and wage responses for workers differentiated on the basis of skill level	While the short-run effect of oil price increases on aggregate employment is negative, the long-run effect is negligible. Find that oil price shocks induce substantial changes in employment shares and relative wages across industries. However, found little evidence that oil price shocks cause labor to flow into those sectors with relative wage increases.		Uses regression analysis.
Lee et al. (1995)	1950-1992	Objective: Examining causality of real oil price to the macro economy through 1992	In a long period of stability, oil price shocks (= surprise) have a greater impact than in a volatile environment. For output growth in a 24-quarter horizon the largest negative impulse appears 4 quarters after the oil price shock, recovery begins about 6 quarters after the shock. Unemployment begins to rise 4 quarters after the oil shock through 8 quarters after the shock that is not offset at later dates.	The important point of this study is the inclusion of the variable oil price shock, that means the measure of how a change in the given oil price differs from the historical pattern.	
Loungani (1986)	1947-1982,Quarterly employment data for 28 industries	Assumes that disruptions in the world oil market generate significant unemployment through sectoral shifts.	Oil price increases in the 1950s and 1970s appear to account for disturbing the labor reallocation process.		
Mork (1989)	1948-1988		Analyses if Hamilton's results remain correct when the oil market collapse of the 1980s and the real oil price are considered as well. Shows an even stronger negative correlation between oil price increase and output growth than Hamilton. Despite of oil price declines in the 1980s, economic output growth is slowed down by oil price changes ® asymmetry in effects.	Confirms Hamilton's (1983) observation of a negative correlation between output growth and oil price increases and extends data until 1988.	
Papapetrou (2001)	1989-1999 for Greece		In a mid- and long-term relationship, oil price shocks account for 20% (up to 22%) of change in industrial production. 1) Effects of an oil price shock including industrial production: Immediate increase of interest rates and Immediate decrease of industrial production (peak after 4 months). 2) Effects of an oil price shock including employment: Immediate increase of interest rates, Decrease of employment (after 4 months), Decrease of real stock returns		
Rotemberg and Woodford (1996)	1948-1980		Imperfectly competitive market models can explain the great effect of oil price changes on output growth and real wages. A 1% increase in oil prices results in a reduction in output of about -.25 percent after 5 - 7 quarters. After an oil price increase of 10%, real wages fall by 1% after 5 or 6 quarters after this increase. The decline in output and real wages gains importance in the second year after the oil price shock.		The period chosen seems to weaken the qualitative results because oil price declines and volatility occur in the 1980s.
Sadorsky (1999)	1947-1996		The average value of a negative shock is 20% larger in absolute value than the average value of a positive shock. Oil price shocks have an immediate significant impact on real stock returns, this impact was strongest after 1986. Increasing oil prices depress real stock returns. After 1986 there's rather a change in dynamics than a change in the response of the system. Thus, oil price volatility shocks play an important asymmetric role.	The study back up the results of Jones and Kaul by using monthly data instead of quarterly data.	
Sauter & Awerbuch (2003)	1948-2003	Paper provides a lit review of recent research in the area of oil price movements and their effect on economic and financial performance in IEA countries	Oil price volatility is more significant in its effect on economic activity than the oil price level. A volatile environment weakens the effect of price level changes since it reduces the "surprise." Increasing volatility creates market uncertainties that induce companies to postpone their investments. Furthermore, volatility affects labor markets by disturbing the reallocative process among sectors. Again, it is the surprise of an oil price increase that matters	Makes connections to the vast majority of works described above. This table is a product of this paper and has been built upon by other research.	